Science Assessment System Through Course Task

Giant Fruits and Vegetables

Grade Level:
7

Phenomena:
Environmental Influence on Plant Growth

Science & Engineering Practices:
Analyzing and Interpreting Data
Constructing Explanations and Designing Solutions

Crosscutting Concepts:
Patterns
Cause and Effect

Designed and revised by Kentucky Department of Education staff
in collaboration with teachers from Kentucky schools and districts.

Preparing to implement Through Course Tasks in the Classroom

What is a TCT?

- TCTs are 3-dimensional tasks specifically designed to get evidence of student competency in two dimensions, Science and Engineering Processes (SEPs) and Crosscutting Concepts (CCC), untethered from Performance Expectations (PEs)/standards. Tasks are sense-making experiences.
- Tasks are to be used formatively. The goal is for both students and teachers to understand areas of strength and improvement for the SEP(s) and CCC assessed within the task.

How do I facilitate a Through Course Task (TCT)?

- TCT facilitation is a collaborative process in which teacher teams calibrate understanding of the expectations of the task and refine strategies to be used during task facilitation.

Before the task:

1. Complete the TCT as a learner – compare understanding of task through the lens of success criteria (identified in the task) in order to understand expectations.
   Success criteria include:
   - What is this task designed to get evidence of?
   - What is the task asking the students to do?
   - What might a student response look like?
2. Identify the phenomenon within the task. Consult resources to assure teacher teams have a deep understanding of associated science concepts.
3. Collaborate to generate, review and refine feedback questions during facilitation.
4. Identify potential "trouble spots" and plan for possible misconceptions.

During the task:

5. Collect defensible evidence of each student's competencies in 3-dimensional sense-making for the task.
6. Ask appropriate feedback questions to support student access and engagement with the task in order to elicit accurate evidence of student capacities.

After the task:

7. Reflect on the task as a collaborative team.
8. Review student work samples to identify areas of strength and areas of need.
9. Determine/plan next steps to move 3-D sense making forward through the strengthening of the use of SEPs and CCCs.

Using the materials included in this packet:

- **Task Annotation:**
  - The task annotation is a teacher guide for using the task in the classroom. Additionally, the annotation gives insight into the thinking of developers and the task overall.

    - Each task has science and engineering practices, disciplinary core ideas, and crosscutting concepts designated with both color and text style:
        - **Science and Engineering Practices**
        - *Disciplinary Core Ideas*
        - Crosscutting Concepts
- **Student Task:** The materials to be used by students to complete the TCT.

Giant Fruits and Vegetables Task Annotation

After **analyzing and interpreting data** *about the growing seasons of Fairbanks, Alaska and Lexington, Kentucky*, **construct an explanation** for what causes *fruits and vegetables to grow much larger in Fairbanks, AK than Lexington, KY*.

Phenomenon within the task

This task presents the phenomenon that fruits and vegetables can grow much, much larger in Alaska than Kentucky. Although many variables can affect plant growth, the significantly increased hours of sunlight experienced in Alaska provides much more energy to the plants to support photosynthesis, producing much larger fruit (if other variables are held constant).

A possible student misconception is that plants take the all the substances they need to grow through their roots. Students may lack an understanding of the basic process of photosynthesis. They may view sunlight as useful but not essential for plant growth. Lastly, students may not understand that the energy from the sun allows plants to carry out photosynthesis and produce sugars. Cellular respiration breaks down these products and chemically changes them into energy for the plant.

How the phenomenon relates to DCI

PS3.D: Energy in Chemical Processes and Everyday Life

- The chemical reaction by which plants produce complex food molecules (sugars) requires an energy input (i.e., from sunlight) to occur. In this reaction, carbon dioxide and water combine to form carbon-based organic molecules and release oxygen. (Secondary to 07-LS1-6)

LS1.C: Organization for Matter and Energy Flow in Organisms

- Plants, algae (including phytoplankton) and many microorganisms use the energy from light to make sugars (food) from carbon dioxide from the atmosphere and water through the process of photosynthesis, which also releases oxygen. These sugars can be used immediately or stored for growth or later use. (Primary to 07-LS1-6)
- Within individual organism, food moves through a series of chemical reactions in which it is broken down and rearranged to form new molecules, to support growth, or to release energy. (Primary to 07-LS1-7)

What information/data will students use within this task?

- Background information, including images, on the growth of vegetables in Fairbanks, Alaska and Lexington, KY. A brief summary of how plants obtain their energy/food through the process of photosynthesis.
- Two data sets (in table format) for the growing seasons of Fairbanks, Alaska and Lexington, KY.
- Prior skill acquisition of data analysis and using evidence to construct an explanation using claim, evidence and reasoning.

Ideas for setting up the task with students

Students should have previous experiences with analyzing multiple data sets at a time, looking for patterns in data and writing scientific explanations using claim, evidence and reasoning. Provide additional support/clarification for students that will support the development of their scientific explanation such as the one shown below.

> ***The following steps will support the development of your scientific explanation:***
> Your explanation should include a claim, evidence that supports the claim and includes actual data from the two data tables and reasoning that connects a scientific concept or a scientific principle describing why your evidence supports your claim.

Intent of the Task for Assessment

This task is intended to get evidence of a student's ability to analyze data to identify patterns and then connect an identified pattern to causality in order to explain a phenomenon. The student's understanding of the causal mechanism for the phenomenon is demonstrated by constructing a scientific explanation. More specifically, students are asked to analyze some general data to compare growing season characteristics between Fairbanks, AK and Lexington, KY, and after being prompted to reflect on the process of photosynthesis, explain what aspect of the data could provide evidence of the cause for the much larger fruit and vegetable size in Alaska.

The structure of the task is intentional in an attempt to authentically elicit a student's ability to analyze data for patterns, and use the identified pattern to link to causality as they construct their explanation. First, the students are provided text and photographs about the giant fruit and vegetables in Alaska. Students are told that scientists look for patterns in data related to a phenomenon, and then look for a cause for the pattern to help explain the phenomenon, and asked, "Don't you wonder why fruits and vegetables can grow so much bigger in Alaska than in Kentucky?" They are provided a data tables for the two locations with three variables:

monthly average temperature, monthly average hours of sunlight per day and monthly average rainfall. Students are asked to analyze the data, look for patterns and make comparisons of the growing seasons between the two locations. Although there are three variables in the data set, students are only asked to make two statements about the data. If the task asked for one statement, then the student may only look at the first variable; if the prompt asked for three statements, then the student might just mechanistically look at each of the three presented variables. Asking for two statements was an attempt to keep things open. The student statements could be comparing one variable at a time, or multiple variables. But the point of part A in the task is, can the student analyze the data and make an accurate statement about how the two locations compare?

Students are then reminded about the role of photosynthesis in plant growth. Students are expected to have been exposed to the process of photosynthesis by 7th grade, and the task is not intended to measure their ability to recall photosynthesis from memory, but it does measure their ability to *apply* an understanding of photosynthesis. Students are asked to reflect on their statements in the context of plant growth through the process of photosynthesis. Although this may seem leading for the student, the intent was to get clear evidence of their ability to construct an explanation with an emphasis on causality (*why* the fruits and vegetables grow bigger in Alaska).

Success Criteria

Evidence of Learning Desired based on Progression from Appendices

Analyzing and Interpreting Data

- Analyze and interpret data to provide evidence for phenomena.

Constructing Scientific Explanations

- Construct an explanation that includes qualitative or quantitative relationships between variables that predict(s) and/or describe(s) phenomena.
- Apply scientific reasoning to show why the data or evidence is adequate for the explanation or conclusion.

Patterns

- Graphs, charts and images can be used to identify patterns in data.
- Patterns can be used to identify cause and effect relationships.

Cause and Effect *(can be applied in the Reasoning Section, Part C of task)*

- Cause and effect relationships may be used to predict phenomena in natural systems.

Success Criteria

- The student makes two statements that accurately compare characteristics about the growing seasons between Fairbanks, AK and Lexington, KY, that are supported by evidence from the data in the tables provided.
- The student constructs a scientific explanation that relates analysis about the growing seasons to a causal reason based on the fundamental aspects of the process of photosynthesis – explaining why fruits and vegetables grow so much bigger in Alaska than Kentucky.

Possible Student Responses

Part A

- Statement and evidence - Over the growing season, Lexington had an average higher temperature than Fairbanks. Lexington's average temperature for the growing season months was 66 degrees F, compared to Fairbanks' average for the months which was only 46 degrees F.
- Statement and evidence - In both places, the average temperatures increased from April to July, then decreased from August to October. In Lexington, average temperatures were 53, 63, 71, 76, 74, 68, and 56 degrees F. In Fairbanks, average temperatures were 30, 48, 59, 62, 56, 45, and 25 degrees F.
- Statement and evidence - Over the months of the growing season, Fairbanks had a greater average of hours of sunlight with 16.4 hours, compared to an average of 13.9 hours in Lexington.
- Statement and evidence - In both places, the average hours of sunlight increased from April to June, but then decreased from July to October. In Lexington, the average hours of sunlight were 13.1, 14.1, 14.8, 14.5, 13.4, 12.2, and 11.6. In Fairbanks, the average hours of sunlight were 15.2, 18.5, 21.2, 20.7, 16.8, 13.2, and 9.5 hours.
- Statement and evidence - In June, Lexington's average hours of sunlight was only 14.8 hours, but in Fairbanks there was an average of 21.2 hours of sunlight.
- Statement and evidence - Each month Lexington had a higher average amount of precipitation. Lexington's average precipitation total was 653 mm compared to only 206 mm total of averages in Fairbanks.

Part B

- The factors that are necessary for plant growth/photosynthesis are sunlight, carbon dioxide and water. If the fruits and vegetables grow bigger in Fairbanks than in Lexington, the claim about amount of precipitation being higher in Fairbanks is the one that most accurately could explain this. Claim and evidence - This is the claim and evidence. "Over the months of the

growing season, Fairbanks had a greater average of hours of sunlight with 16.4 hours, compared to an average of 13.9 hours in Lexington."

Part C

- Explanation, including claim, evidence and reasoning.
- Over the months of the growing season, Fairbanks had a greater average of sunlight hours with 16.4 hours, compared to an average of 13.9 hours in Lexington. Therefore, the fruits and vegetables grow much bigger in Fairbanks because of the longer hours of sunlight. The sunlight allows or fuels the extra growth of plants there through the process of photosynthesis or greater flow of energy going into the system (plants). The more sunlight, the more food/energy made for the tree, and the greater the amount of growth.

Other information teacher teams might find useful when preparing to use this task in the TCT process

Give students prior experiences in making multiple claims based analysis of data and utilizing claim/evidence/reasoning.

Extensions and/or other uses after the task is implemented

Many middle school students struggle with writing scientific explanations for a variety of reasons. Having students analyze student explanations for strengths and weaknesses can help students improve. One way to do this could be to select a range of student explanations for the task, and have students work in groups to do any of the following: rank the explanations from high to low, do a "plus/delta" for each explanation (identify something effective, identify something to change) or simply improve each explanation and then share with the other groups.

Through Course Task – Giant Fruits and Vegetables

Alaskan Farmers have produced some of the world's largest recorded vegetables including a 19-pound carrot, 127-pound cabbage, 29- pound green zucchini, and 7-pound tomato. A few of these giant Alaskan vegetables are pictured below. In contrast, the vegetables grown in Kentucky are much smaller or "normal" size.
https://www.farmflavor.com/alaska-agriculture/

(Image Courtesy: State of Alaska)

"Giant Zucchini" by BarbaraLN is licensed under CC BY-SA 2.0

"Which One's Cabbage" by Mike Kirby is licensed under Creative Commons Attribution-Share Alike 2.0 Generic license

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Scientists often look for patterns in data to stimulate thinking about a possible cause for a phenomenon. Don't you wonder why fruits and vegetables can grow so much bigger in Alaska than in Kentucky? The following page has two data tables with monthly information about conditions during the growing season for Lexington, Kentucky and Fairbanks, Alaska. Use these tables to complete the task that follows.

The two data tables below show the growing seasons of Lexington, Kentucky and Fairbanks, Alaska

Table 1: Lexington, Kentucky Growing Season Data

	April	May	June	July	August	September	October
 Average Temperature °F	**53 °F**	**63 °F**	**71 °F**	**76 °F**	**74 °F**	**68 °F**	**56 °F**
 Average Hours of Sunlight per Day	**13.1 hrs.**	**14.1 hrs**	**14.8 hrs**	**14.5 hrs**	**13.4 hrs**	**12.2 hrs**	**11.6 hrs**
 Average rainfall in millimeter (mm)	**95 mm**	**119 mm**	**89 mm**	**110 mm**	**89 mm**	**86 mm**	**65 mm**

Table 2: Fairbanks, Alaska Growing Season Data

	April	May	June	July	August	September	October
 Average Temperature °F	**30 °F**	**48 °F**	**59 °F**	**62 °F**	**56 °F**	**45 °F**	**25 °F**
 Average Hours of Sunlight per Day	**15.2 hrs**	**18.5 hrs**	**21.2 hrs**	**20.7 hrs**	**16.8 hrs**	**13.2 hrs**	**9.5 hrs**
 . Average rainfall in millimeter (mm)	**10 mm**	**15 mm**	**34 mm**	**49 mm**	**51 mm**	**23 mm**	**24 mm**

Student Tasks:

A. Analyze the data in Table 1 and Table 2 for the growing seasons of Lexington, Kentucky and Fairbanks, Alaska.

- **Make 2 different statements about how conditions are different between Fairbanks, AK and Lexington, KY, based on a patterns you observe in the data.**
- **Include evidence from the data to support each of your statements.** (The evidence should ONLY come from your analysis of Table 1 and Table 2.)

Think about your understanding of what plants need to grow – the factors that affect plant growth through photosynthesis. The process of photosynthesis allows plants to use the sun's light energy to combine carbon dioxide (CO_2) and water (H_2O) to make their food (sugar).

B. Consider each of the 2 statements that you made in Part A with respect to the factors that affect plant growth through photosynthesis. Identify which statement would most likely provide evidence to explain why fruits and vegetables grow so much bigger in Alaska than Kentucky. If neither one of your statements from Part A provides evidence to support why fruits and vegetables grow bigger in Alaska than Kentucky, then revisit the data and make a third statement from the data sets that could support an explanation for this phenomenon.

C. Construct a scientific explanation* to describe *what causes* fruits and vegetables to grow so much bigger in Alaska vs. Kentucky.

* Your explanation should include a claim, evidence and scientific reasoning based on the data provided and the process of photosynthesis.